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West Europe Report

SCIENCE AND TECHNOLOGY

(FOUO 15/81)

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WEST EUROPE REPORT

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TRANSPORTATION

MERCEDES-BENZ 'AUTO 2000' PROJECT: STATUS REPORT

Stuttgart ATZ AUTOMOBILTECHNISCHE ZEITSCHRIFT in German Sep 81 pp 395-396, 399-401

[Text] Within the framework of the "Research Car" project which is being sponsored by the Ministry of Research and Technology (GMFT) Daimler Benz Inc. is developing a touring car with various kinds of drive. In this report the most important construction groups are described in terms of the present status of the work.*

Abstract

Daimler-Benz AG are developing two research vehicles which will to a certain extent be sponsored by the German Federal Department of Research and Technology. One of the cars will be driven by a two-shaft gas turbine (Fig. 1), the other one will be driven by a turbocharged Diesel engine (Fig. 3).

Development activities concerning the body aim at low aerodynamic drag, low weight, and high safety standards, especially during front collisions which frequently occur in an offset manner (Fig. 5), side collisions, and during accidents with pedestrians.

Great attention is paid to the development of electronics. Besides the well-known anti-lock braking system, a drive control device will be installed for the first time. A radar controlled distance-monitoring system is shown. The driver can choose fuel saving driving programs. The output of various calculators, i.e., a monitoring computer, a trip computer, a route computer are shown on an LCD-monitor (Fig. 9).

When this report was written the Diesel research car (Fig. 10) was just being assembled. Though no driving tests could yet be performed Daimler-Benz are sure to fulfill the stringent requirements for fuel consumption, exhaust and noise emissions, and the safety required by the specification list.

*The author expresses his thanks to his many colleagues who supported him in writing this report.

1. Introduction

The BMFT is supporting the construction of German research cars with the goal of improving, through the application of new technologies, vehicle characteristics which are in the public interest, such as energy consumption, environmental compatibility, safety and economic value.[1]

In contrast to earlier projects, which had a one-sided emphasis on the realization of the greatest possible passenger safety or a high degree of economy, in this instance compromises must be made between the various contradictory demands.

Daimler-Benz Inc. is involved in this project with the development of an automobile in the upper space and weight class, Fig. 1. The spectrum of use with emphasis on extended trips for business, vacation or pleasure with high degrees of occupancy, requires good comfort for long trips in respect to space, air conditioning, driving and noise. This journal carried a report on the design of the vehicle in 1980.[2] There have been no changes in it since then, except for a few details which are to be given special consideration in this report.

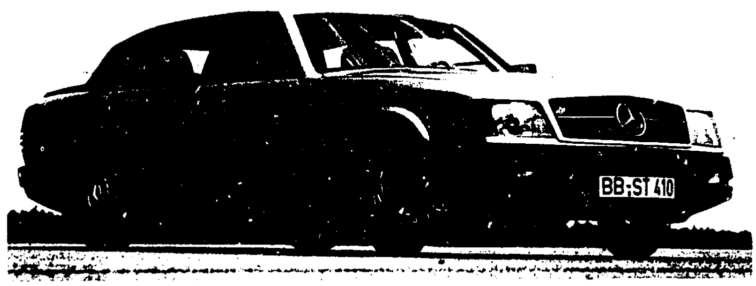

Figure 1. View of the Research Car From Daimler-Benz

2. Drive Units

Since the beginning of the project the plan called for utilizing a gas turbine, which is being developed at Daimler-Benz, to drive the research car. As an alternative to that, two V-8 engines, a gasoline and a diesel engine, were to drive the other research cars. As a result of funding cuts by the BMFT, support for developmental studies on the gasoline engine were given up. The second research car will be driven by a diesel engine which was altered in respect to the original planning.

2.1 Gas Turbine

In order to achieve comparable fuel consumption with gasoline and diesel engines the process temperatures of the gas turbine must be as high as possible. With the new developments which are supported by the German ceramics program of the GMFT, temperatures of 1,600 K appear attainable. They alone make development of a vehicle gas turbine feasible.

The Mercedes-Benz research gas turbine was designed along the lines of the two-shaft type of construction. In Fig. 2, the gas producer with the impeller compressor and the compressor turbine can be seen at the left (in the direction of travel, in the front). The gas producer rotor drives the auxiliary equipment, which is necessary for the car and the turbine, via the gears underneath.

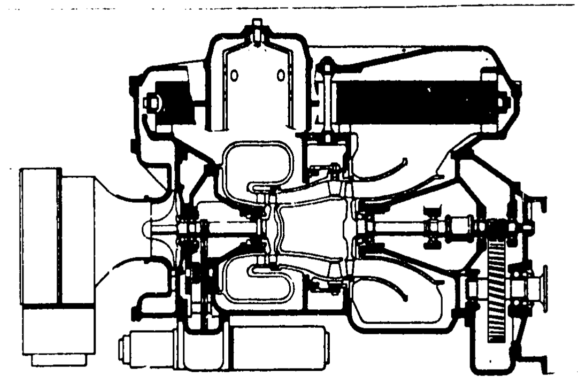

Figure 2. Schematic Longitudinal Cross-Section of the Mercedes-Benz Two-Shaft Gasturbine

The combustion chamber which in this schematic drawing is tilted into the plane of the picture is inclined to the left side of the vehicle by 57°. Its construction permits premixing and prevaporization of the fuel which are essential for low emission of pollutants, Fig. 3.

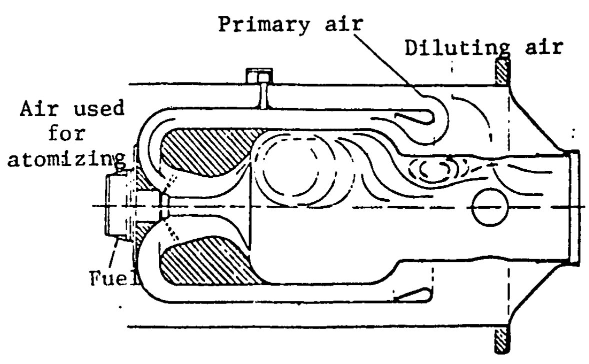

Fig. 3 Schematic cross-section of combustion chamber

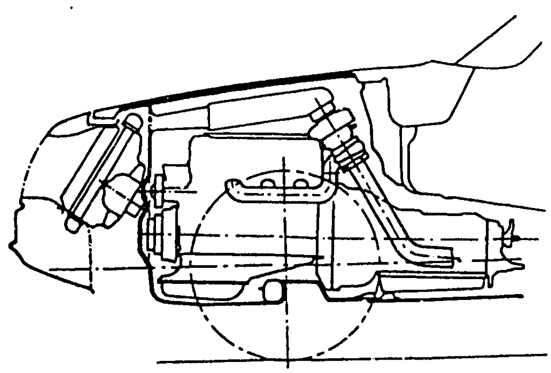

Fig. 4. Installation assembly of the supercharged V-6 Diesel engine in the Mercedes-Benz research car

To the right in Fig. 2, the load turbine rotor with its turbine wheel and the gears are arranged in a common housing part which reduces the maximum rotational speed to 6,500 1/min, the customary value for cars. Connected to this is an automatic variable speed transmission. In front of the load turbine there is an adjustable guide baffle which can be used to slow the car down.

The turbine wheels are made of hot-pressed silicon nitride; the stationary parts which are loaded with hot gas were produced in part from ceramics, in part from high heat resistant special metal alloys.

The turbine inlet spiral made of silicon carbide is shown in the middle of Fig. 2 and is currently being examined on a test stand for components.

The heat exchanger disc of aluminum silicate rotates around a vertical axle. It is driven by the gas producer.

The turbine housing which consists of alloyed spheroidal graphite cast iron was thermally insulated inside with a ceramic fibrous material.

Proof of the efficiency of ceramic integral turbine wheels represented the most important task in an experimental program which has been in progress for several years. Ceramic turbine wheels were tested for 140 hours in stationary and non-stationary test runs with maximum temperatures of 1,523 K and speeds up to 60,000 1/min.

The gas producer part was put into operation at the end of last year. The first run of a full power unit took place in May 1981. An effective power of 94 kW with a combustion chamber outlet temperature of 1,523 K is expected to result. Additional data are contained in [2].

2.2 Diesel Engine

A diesel engine is scheduled as an alternative drive for the research car.

Its design was substantially modified in respect to the initial plans.[2] The 4.4-1 V-8 suction engine was replaced by a supercharged 3.3-1 V-6 engine, also having a rated output of 110 kW, primarily with a view toward a further lowering of fuel consumption, more favorable conditions of installation and lower weight.

The light metal engine block with a 90°V-angle has dry gray cast iron bushings. The cylinder heads are also made of light metal. Ceramic port liners are supposed to reduce the heat of the cooling water and contribute to better utilization of the exhaust gas energy. The valves are controlled by an overhead cam shaft per row of cylinders and cup tappets with automatic valve clearance compensation. The precombustion chamber process is utilized because of its low noise level and the smoke behavior, which is satisfactory in all states of operation, with good fuel consumption. An effort is being made to favorably influence particle emission by changing details in the precombustion chamber.

The series injection pump is located between the cylinder heads. It is jointly driven with the cam shafts by a double roller chain.

The arrangement of the two exhaust gas-turbo-superchargers with a 60° incline is new, Fig. 4. They are driven by a multiple switch system in such a way that under 2,400 l/min only one rotor operates, above that, both. From this arrangement we can anticipate both better torque characteristics with low rotational speeds and a better time response.

All auxiliary systems are driven by a polyvinyl belt with an automatic belt tenser. The crankshaft belt disc has a two-gear planetary gearing system which in the case of low engine speeds makes possible sufficiently high speeds for the auxiliary units.

Engine and gears are enclosed to meet the specified noise requirements.

2.3 Driving Programs

In actual driving operation fuel can be saved if the driver voluntarily does not use part of the engine output. As an aid in driving three driving programs are to be offered for the driver to choose from for this purpose:

Economy--by adjusting the injection pump and gears, output and maximum speed are limited.

City--low shift speeds in the automatic transmission keep fuel consumption and emissions low.

Fast--makes it possible to utilize full engine power.

The automatic transmission is electronic-hydraulically controlled in such a way that in all the driving programs the most consumption-favorable gear is chosen as needed.

3. Body

In addition to high level riding quality for four to five people with sufficient luggage, the goal of the development work on the body is low drag, lowering the weight, testing new air conditioning equipment and increased safety for passengers and for people outside the car who are involved in an accident.

3.1 Aerodynamics and Weight

The area of drag surface $c_p \cdot A$, which is decisive for air resistance, is to be lowered to 0.6 m^2 which means--compared with the S-class limousines which today are already favorable--a 20-percent improvement. Since in spite of a slight lowering of the roof because of the requisite interior space and the essential protection against side collisions the front area could be reduced only insignificantly to 2.09 m^2 this requirement means a drag coefficient under 0.3.

Changes in respect to today's vehicles were done primarily in the rear. The flow affects the entire length of the "Kamm"-like roof. It was possible to achieve substantial c_p value improvements by enclosing the underfloor, elevating the spare wheel well along the back edge, and by spoilers in front of the rear wheels. Additional decreases in drag resulted from optimizing the front and grille, by carefully directed cool air ducts and by flush side windows.

Fig. 5 shows the clay model which was built for the wind tunnel experiments; it has an original underfloor and an original undercarriage. The very favorable measurement results are to be checked with car bodies as soon as these are available.

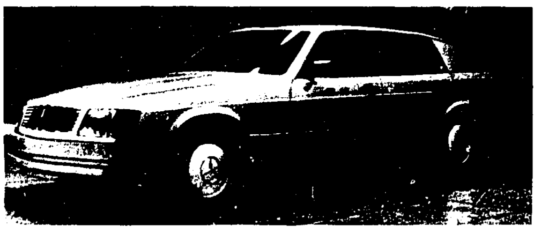

Fig. 5. Wind channel model of the Mercedes-Benz research car

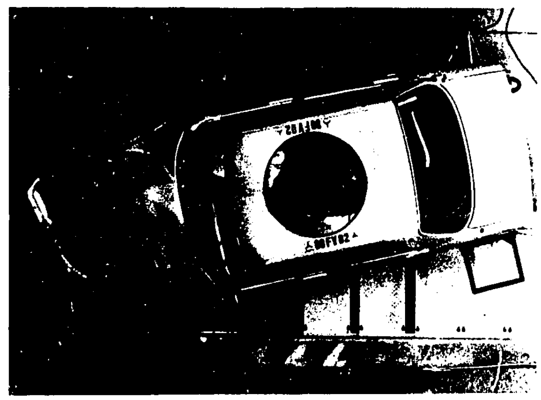

Fig. 6. Experimental base after crash upon stage barrier

The two-sheet doors were made of sheet aluminum. Their windows are plastered over with the light metal frames except for small communication windows in the front doors.

For the front mud guard, bumpers and the soft nose glass-reinforced polyurethane was used, in part with an energy-absorbing foamed plastic support.

By these measures, in spite of the extra weight required elsewhere for safety measures, the weight of the body could be lowered by 5 percent as compared with the S-class which was used as the basis.

3.2 Heat and Air Conditioning

With the Daimler-Benz research car for the first time an effort is being made to utilize the technique of heat pipes, which is familiar from the cooling of electronic components, for comfort control in the interior. On the one hand the light and compact heating heat exchanger can transfer engine heat from the cooling water to the heating air and, on the other hand, release air heat to the coolant of the air conditioning system. Thus, there is no need for a separate air conditioning heat exchanger.

Since heat pipes can also be designed as sheetlike heaters, it is obvious to use them to heat the interior body surfaces. Such units are also being tested in the doors of the research car.

APPROVED FOR RELEASE: 2007/02/09: CIA-RDP82-00850R000400070060-4

3.3 Safety

Measures to impove passive safety refer primarily to protecting the passengers in the event of front and side collisions and to protecting pedestrians.

3.3.1 Front Collisions

Statistics from Daimler-Benz and Peugeot-Renault show that front collisions involving AIS 3+-injured passengers (badly or fatally injured) take place 50 percent of the time staggered to the left hand side. In contrast to the center collision which occurs in only 29 percent of the cases, the driver is thus especially in danger since only the left-hand area of the front, rather than the entire front section, is available to absorb the energy of the collision. Moreover, the driver is limited in his deceleration space by the steering column and pedals. Also the frequency at which seats are occupied (driver's seat: front seat passenger: back seat = 4:2:1) calls for additional protection for the driver. In the research car, therefore, the following safety components are being realized:

--reinforced front and passenger seat structure on the left

--engine hood which is buffered and stressed on the left

--improved coupling of the right front structure via fender holders and engine hood

--disengaging, by means of aramide corrugated tubing, the steering gear-steering wheel connection in the event of a collision.

In Fig. 6 a vehicle is depicted after collision with a staggered barrier.

The following provisions are being made for all passengers:

--improved active restraining sytem with three seatbelt anchor points on the seat, Fig. 7

--passive support of the belt system by an airbag in the steering wheel and belt tighteners on all seats

--exchangeable child's seat in the back with a deflecting table, Fig. 8

--integrated head rests on the front seats, head rests in the back seat which can be put into position if the seat is occupied.

3.3.2 Side Collisions

In this case there is no significant difference in the frequency of accidents between the left and right side of the car. Thus, on the right and left the following safety measures are being tested:

--clawing of the doors with the longitudinal members and the bases of the B-columns in case of a collision

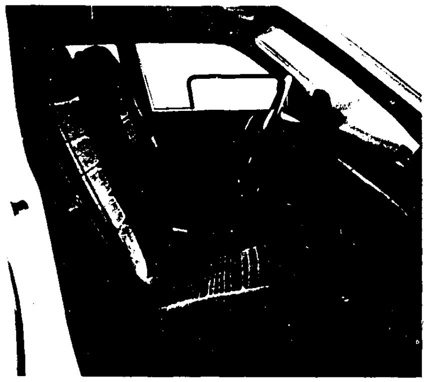

Figure 7. Front seats with integrated head rests and three-point belt system

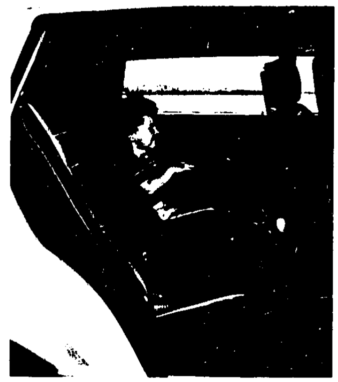

Figure 8. Rear seat with exchangeable children's safety seat and automatic head rests

--increased cross-bracing for the passenger seat

--large surface hip impact zones

--side windows of impact resistant acrylic glass.

3.3.3 Pedestrian Protection

The worst injuries to pedestrians come from contact with the vehicle front. Thus, among other things, the following injury-ameliorating measures are to be tested on the research car:

--soft bumper having the area of contact with the lower leg placed low

--low course of the front contour with soft nose and impact-yielding diffusion windows

--elastic mud guards and A-column coverings.

Fig. 9 gives an idea of the rounded front contour.

4. Chassis

The chassis basically corresponds to that of the S-class cars with hydropneumatic springing available on special order. Changes are to save weight. Thus, for example, wheel rims of light metal are used. In place of the usual spare wheel a light emergency wheel is available.

Parts of the hydropneumatic springing are made of light metal, the front torsion bar has a pipe section. The cardan shaft is produced as one piece from carbon-fiber-reinforced plastic.

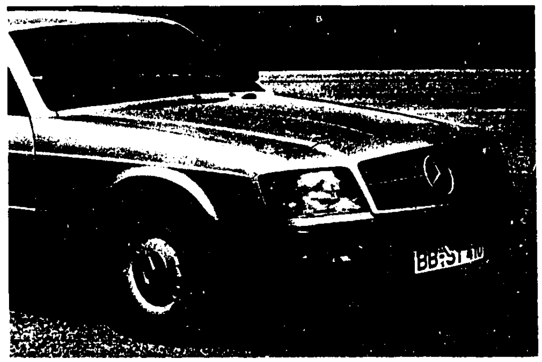

Fig. 9. Front area of the research car

5. Electronics

To a greater degree than to date the use of electronic components to increase safety and to process information for the driver is to be tested.

5.1 Control of Forward Traction

In addition to the familiar brack slipping control (ABS) a control for forward traction in this car will control the frictional connection between tire and road.

5.2 Distance Warning Device

A radar distance warning device, which has been under development for several years,[3,4] is to be demonstrated in the research car.

5.3 Multiplexing Cabling

The large number of electrical consumers in the car and the necessary expensive and heavy cable trunk demand modern solutions for the electrical equipment. The research car, therefore, is to be equipped with electronically controlled multiplex cabling whose advantages lie in low weight, simple diagnosis capability and in the flexibility of the vehicle equipment.

5.4 Driver Information System

A new driver information system in the car is to represent the latest developments in the area of electronic information production and reproduction in the car.

5.4.1 Control Units

The control units consist of liquid crystal monitors. Information in the form of text, numbers or symbols can be displayed. The to date familiar instruments are no longer present as "hardware," but are stored as "software" in the computer. They appear on the monitor when the driver wishes, or when the condition of a unit is critical. In order not to distract the driver constantly, the volume of information is normally restricted to the essentials: driving speed, fuel level, time and mileage, Fig. 10. Individual desires for information can be met. The instrument computer generates those instruments which can support the driver in specific situations: speed revolution counter, oil pressure gauge or coolant temperature gauge.

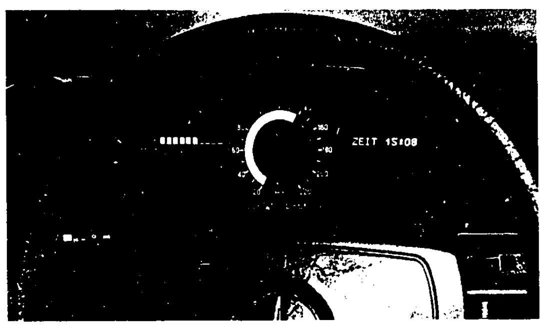

Fig. 10. Control unit of the research car

5.4.2 Monitoring Computer

The monitoring computer stores data about machinery condition and the condition of components which are important for safety. It reports these values to the driver as soon as they exceed a critical threshold. Indications from the monitoring computers can only be canceled by eliminating the cause of the problem.

5.4.3 Maintenance Computer

From the monitoring computer data the need for service is calculated from driving distance, fuel consumption, brake lining wear and filter condition.

Variable maintenance intervals are thus possible.

5.4.4 Trip Computer

By measuring fuel use and the route the trip computer ascertains fuel consumption and makes the influence of the driver clear. Other values such as average consumption values and range can be derived.

5.4.5 Route Computer

The route computer is an electronic atlas whose data at present cover the FRG autobahn system. After input of starting point and destination it develops the shortest routing and indicates the successive junctions with directional hints. The planning of roundabout routes is possible. In today's stage of improvement, the route computer is autonomous to the vehicle.

By coupling with existing traffic radio or tracking facilities the automatic indication of detours is also possible. Experiments with the Institute for Radio Technology in Munich are underway.

5.4.6 Communication System

A driver communication system is being developed with which calls using the public telephone system can be made, emergency calls can also be made and traffic information can be received. Along main roads this system works with sending and receiving devices, which are built in and are permanent, and with antenna. The goal of this development is to clearly reduce the instrument cost for the car owner.

The real problem in using many computers rests in their maintenance and in the organization of the data flow which a central information computer controls.

Dialing and adjusting the computers and the radio, the air conditioning system and the communication system is done with a few keys on the middle console and a keyboard on the steering wheel which controls the devices in a menu technology familiar from EDP.

6. Cooperation

As in the development of any new car countless people are also involved in a research car without whose cooperation the developmental goal in this short time could not have been achieved. Thanks is expressed here to these people without mentioning individual names.

7. Status of the Work

At the time of writing this report the first of the two planned research cars is being outfitted. New ideas and technologies are to be tested with them which if they prove themselves could help out in the future in overcoming the increasing demands on the car. Thus far no measures could be effected on the car. Yet it is anticipated that the specifications required in the bid concerning consumption, emission and safety will be able to be met.

FOOTNOTES

1. J. Bandel, "The Research Car." ATZ, Vol 82, No 2, 1980, pp 59-62.

2. B. Strackerjan, "Basic Conditions for Automobile Construction in the Future and Their Effect on the Mercedes-Benz Research Car," ATZ, Vol 82, No 2, 1980, pp 69-74.

3. S. Reiniger, "Driving Tests in Street Traffic Using Radar-Controlled Distance Warning Devices. Lines of Development in Vehicle Technology and Road Traffic 1980," Cologne, pp 204-213.

4. G. Neininger, "Measurements With FM/CW Radar in the Context of the Test Program for Self-Sufficient Distance Warning Systems. Lines of Development in Vehicle Technology and Road Traffic 1980," Cologne, pp 214-222.

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TRANSPORTATION

PHASE TWO OF VOLKSWAGEN 'AUTO 2000' PROJECT COMPLETE

Stuttgart ATZ AUTOMOBILTECHNISCHE ZEITSCHRIFT in German Sep 81 pp 407-410

[Text] Abstract

VW-Vehicle 2000 is an abbreviation of the project officially entitled: "Demonstration of Automotive Research Results of Integrated Concepts of Experimental Passenger Cars," which is sponsored 50 percent by the German Federal Ministry of Research and Technology. This project was started as an exemplary project for the German automobile and the supplying industry. Six contractors developed the specifications for the cars in phase 1. Phase 2, currently in progress is being carried out by four contractors with the aim of building the prototypes to these specifications. The program ends in 1982 with phase 3, the prototype testing.

This article describes VW's contributions to this project emphasizing a vehicle in the size middle class of the Volkswagen Golf.

Introduction

From Volkswagen's point of view the goal was to offer as balanced a compromise as possible between the various anticipated future requirements. On the one hand, these requirements stem from the future international market situation, on the other hand, from the pressures to protect limited resources and the environment, to increase safety and social and political demands.

In order to clarify these complex relationships and to develop criteria for evaluating technical solutions to the questions of the 1990's, the general context of the automobile of the 1990's has been described in a broadly based scenario. Parallel with that numerous technical design studies were carried out, for example, reducing vehicle weight, decreasing air resistance, improving the drive, the use of electronics, the use of alternative materials, and the like, and were evaluated with the help of the scenario and an extensive analysis of economic value. In the process strict attention was paid to the fact that it must be possible to realize the technical solutions in mass production in the time frame to be considered.

The design of the research car developed at Volkswagen stands out because of its great flexibility which is very important from our point of view since the

Table 1. Technical Data of the VW Auto 2000

Dimensions (mm)

Exterior		Interior	
Length	4,105	Finished space	1,825
Width	1,670	Elbow width front/back	1,455/1,426
Maximum height (empty)	1,353	Headroom front/back	956/923
Wheel base	2,450	Trunk space (VDA Quader)(1)	320
Wheel track front/back	1,410/1,358	Seating area (m^2)	2.66
Road clearance (empty)	150	Clear door opening width	1,147
Turn radius (m)	10.5	Clear door opening height	902
Drag coefficient	0.26	Weight empty (kg)	780
Cross-sectional area (m^2)	1.86	Load (kg)	400
Operating range (km)	= 1,400(diesel)	Rim size (inches)	13
based on ECE cycle	= 800 (gasoline)	Tire size	155/70

Drive	Diesel Engine	Gasoline Engine
Nominal rating (hp/kW)	45/33	75/55
Displacement (1)	1.2	1.05
Rated speed (1/min)	4,000	5,800
Torque (Nm)	98	106
Speed at M_{max} (1/min)	2,500	4,000
Supercharging	0.6	0.5
Ignition	--	Identifying field controlled HTZ [high output transistor ignition system]
Number of cylinders	3 R	4 R
Compression	20	8.3
Mixture formation	Injection	Injection
Engine construction	Light construction in vehicle enclosure	Light construction in vehicle enclosure
Transmission	Gear shift 4+E	Automatic

development of the energy situation is associated with too many uncertainties. The suggested design provides for the car of the 1990's to have the basic conditions for less consumption because of less drag and less vehicle weight, yet, on the other hand, through appropriate motorization to permit reaction to an intensified energy situation by means of extremely economical motorization and a very efficient version.

Design Description

This research car from Volkswagen is designed as a two-door fastback car. As a four-seater it will permit over 400 kg additional load. The luggage compartment in the rear can accommodate a large number of transport tasks by means of various combinations with the back seats. The overall design provides for two differently outfitted variants, the normal version with a diesel engine as an extremely economical vehicle with today's road performance and a luxury version with a gasoline engine. The average useful life will exceed 10 years and will be equal to a road life of at least 140,000 km. Table 1 gives a short description of the car using technical data.

What special features distinguish this car? For the first time a new strategy was tested in shaping the body. Thus, the primary consideration was the requirement of a minimal drag coefficient. On the basis of the first form studies in the wind tunnel, which recorded extreme proportions for the car body, our design center, with consideration of the typical VW conception, developed a form which we consider to be a successful synthesis of aerodynamics, technology and form aesthetics. This was accomplished by constant interaction on the part of aerodynamic engineers, stylists and designers, Figures 1 through 4.

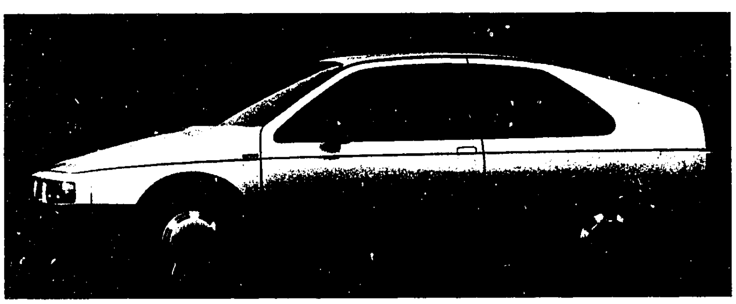

Fig. 1. Distinct side view of the VW-Auto 2000 with extremely low c_D-value(0.26), with both, 33kW (42 HP), 1.2-litre-Diesel engine and 55kW (75 HP), 1.05-litre gasoline engine with front-wheel drive

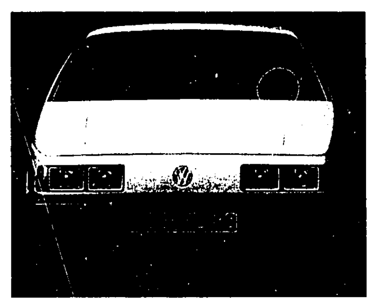

Fig. 2. Front view of the VW-Vehicle 2000 with twin headlamps

Fig. 3 and 4. Other views of the VW-Auto 2000, with Kamm-rear end made of plastic material and clear styling all-around

The demands of aerodynamics resulted in a number of new design principles, for example, windows which close with the exterior covering, smooth underfloor, the shape of the wheel discs. Even the cooling air duct for the entire area was chosen in such a way that flow-through losses could be minimized. The air enters in the front of the car in the lower baggage area and exits in the front part of the engine hood. This in turn required completely new ducting for interior ventilation. Fresh air enters in the area of the front mud guards and exits in the rear roof columns.

Body Development and Design

Today's mass-produced bodies consist of a large number of shaped sheet metal parts which are welded together. In each case, an essential component of this shell is the support system or the structural design which serves to receive and transmit the forces which affect the car. This structural design takes on special importance in respect to vehicle safety, that is, in respect to deformation in the event the car collides with an obstacle. The production and processing of these many parts requires a costly manufacturing operation.

In order to reduce this cost, to optimize the use of the material, to improve corrision protection even more and to further humanize working conditions during production, a radically altered body design was developed. In this, the unfinished body is manufactured of sheet steel parts, which are by and large not interconnected, and the mounted parts are produced to an increasing degree of plastic. The shell consists of only three construction groups which can be fully automatically produced: floor group, side parts and the cross-connections with the roof in the roof area.

The following mounted parts are also made of plastic: forward part of the front, rear section, rear door, back part of the mud guard in front with the wheel house and integrated wheel bead and the lower side part in the back which likewise is supplied with wheel house shell and integrated wheel bead. These parts are put together in the final assembly phase.

This body design can be characterized as a hybrid method of construction because essential components are manufactured from other materials and bolted together. Of course, this method of construction has become possible only in connection with a very refined support system design which permits identical kinds of rigidity of the body with torsion and bending.

Car Interior

The functional area, the dashboard with the instrument panel, the immediately visible digital controls, even the inner assembly which is not visible, embody a new design. In this assembly all the components which normally have to be mounted individually in the front interior space are integrated.

As the base for this assembly, the backbone so to speak, there is a flexurally rigid support which during final assembly is mounted with the complete dashboard between the hinge columns.

The numerous individual elements which are integrated in this assembly are the following: knee cushion with tray, adjustable steering column with support, accelerator, electronically controlled heating and ventilation system, glove compartment and glasses case, ash tray with cigar lighter, movable interior lights, car door electric contact switch, stereo system with cassette deck and full electronic controls, the front stereo high-output speaker and, so to speak, as the electronic heart, the central digital controls in the attachment on the steering column which moves along with the height adjustment. Thus, these controls are not obscured by the steering wheel rim.

As a subsystem, this attachment to the steering column contains the central electric units, the fuses, an audio response unit and the central controls already mentioned. This is done in liquid crystal technology and divided into rou roughly three equal fields: the fields to the right and left serve to indicate operation and trip information while the middle display is used for ALI, the driver's guidance and information system. The indicators for car speed and engine speed in the left and right hand sections are very distinct in digital numbers. Above these large numbers there is, as the case may be, a row of displays for warning indicators, for example, for legally prescribed controls (turn indicators, bright lights). Other control functions are indicated only via a general warning display, however, at the same time they are specially described by the synthetic audio response unit.

As a numerical display, the lower side displays serve multifunctional tasks and can show various kinds of information upon request from the driver via keys, for example, fuel level, route, average speed, time, date, and so on. In the design of this central control unit special attention was paid to keep from transporting the driver into the world of an airplane cockpit and feeling overtaxed. This becomes clearer if the three-way division of information is considered:

--Necessary information which is constantly indicated as for example, speed.

--Warning functions which call attention optically and/or acoustically only if something happens.

--On-demand information which is displayed at the driver's request.

New directions were taken with the front seats, too. The external shape differs from the familiar series-produced seats. Except for a few individual parts these seats are made completely of plastic and are to be manufactured on a mass-production scale as injection-molded parts. The upholstered cushions rest in a shell into which they are clipped. Thus, they can easily be cleaned or exchanged. After detailed computer computations it was possible with this plastic seat, to present the mass-produced VW design of the safety belt element integrated into the seat in such a way that all the safety experts' demands for strength are met.

Like the front seats the back seats also have integrated head supports. The trunk can be altered for numerous transport tasks by lowering the seat back or parts of the back and the seat proper.

The side parts have been designed by the stylists in a way that is visually pleasing and functional. They make a very substantial contribution to the overall luxury impression of the interior.

Chassis Design

The chassis of the front drive Auto 2000 was designed following the high standards which apply to VW-Audi products. Several individual units are worth special mention. The rear axle was made of glass-fiber-reinforced plastic. This extreme use of plastic demonstrates the limits of this alternative material in reference to costs and weight savings. In addition to a number of improvements in details, the installed automatic antilock device (ABV) is particularly important. This was to be an attempt to maintain the steerability of a car while braking using a three-channel system. The results achieved suggest the possibility of a solution, at the cost of a high grade car radio.

With the car wheels of plastic, tires especially low in friction were used.

Overall, optimizing of materials was achieved in body work and chassis by using CAD/FEM (computer aided design/finite element method). In addition to optimal design, production costs and recycling were solved as special tasks.

Drive Designs

Diesel Engine

The particularly economical design solution is represented by a water-cooled three-cylinder direct injection diesel engine. This research design has an electronically controlled injection pump and an exhaust gas supercharger. The crankcase, which is made of molded aluminum alloy, has cylinders with a Nikasil coating. This light construction helps reduce weight.

The amount injected and the beginning of injection are controlled by an electronic system in the injection pump by interrogating the stored identifying field. For this microprocessor technology is put to use. In contrast to the traditional practices the turbosupercharger in this engine serves to produce a good torque at low speeds.

This three-cylinder engine is designed in such a way that now special measures to balance the mass became necessary, as for example, a differential shaft. The characteristic vibrational behavior is accommodated in a motor mount that is coordinated with it.

Gas Engine

The somewhat larger-scale motorization, which was mentioned at the outset, is presented as the so-called luxury version with a water-cooled four-cylinder light metal gasoline engine in series construction with 55 kW.

In order to achieve the driving performance required in the specifications of phase 1, as a suction engine a displacement of ca. 1.6 liters would be required. This design concept, nevertheless, was realized as a supercharged 1.05-1 engine. Compared with the suction engine with larger displacement there are comparable kinds of elasticity, acceleration and speed reserves, yet this engine in normal city operation achieves lower fuel consumption as a result of the smaller displacement.

For supercharging, exhaust gas superchargers or compressors driven by the crankshaft must, of course, be considered. On account of the more favorable toruqe curve when using a compressor, which produces better elasticity at low engine speeds, a Roots compressor driven by the crankshaft was used. A belt drive takes care of exact adaptation of the compressor to the air requirements of the engine; its speed ratio is automatically changed as a function of the engine speed; thus, the compressor runs faster at lower engine speeds and in this way takes care of a constant boost pressure. When running with a partial load the compressor can be separated from the drive via an electromagnetic coupling. Then the engine runs on suction engine operation in a consumption-optimal way. Only if need be, for example, when accelerating, is the compressor switched in. With the compressor switched in the boost pressure is adjusted depending on the position of the accelerator.

Because of the relatively high specific loading, compressor engines tend to knock. In order to guarantee optimal engine operation, provisions must be made in respect to the ignition period in order to avoid knocking combustion.

With the "adaptive" knock-limit control which was developed by VW research the ignition angle identifying field which is stored in the control computer--a high output-transistor-ignition system controlled by the identifying field is used--is individually adjusted in accordance with the knock-limit of the engine. This adaptation is effective over a long term and reacts only to significant changes in the operating condition of the engine (new start, oil temperature, and the like).

When idling the engine speed is kept constant with digital idle stabilization. This measure is necessary since to minimize consumption and pollution the engine operates at idle with a low speed (750 1/min).

To set the mixture, gasoline injection is used; each cylinder is supplied with fuel through a separate injection nozzle. The proportioning is accomplished by an electronic control device which specifies the necessary injection amount for every operating point according to the engine speed and air flow. The preparation of the air-fuel mixture is guaranteed by means of electromagnetic injection valves.

Gear Technology

With the diesel engine the gears are an integrated component of an engine-gear control system which in our company is taken to be an automatic momentum utilization unit. In this system the engine flywheel is separated from the crankshaft by an automatically activated additional coupling. This separation always takes place if the engine does not have to exert any forward motion, that is, thrust phases while moving and when the car is standing still (for example at a red light). At the same time the starting coupling also opens by itself so that the flywheel continues to run freely with a high speed while the engine stops immediately if the fuel supply is shut off. As soon as the driver steps on the gas again, the engine is immediately cranked by the starting clutch. Only carefully coordinated electronic controls provide satisfactory interaction of this function cycle.

For the gasoline engine a special three-gear automatic transmission will be used.

Consumption

With a definite decrease in the c_p value to 0.26, a consumption-favorable diesel motorization by means of a supercharged three-cylinder engine, a refined engine-gear control system in the form of an automatic momentum utilization unit, and in combination with weight-reducing components and tires which are low in running resistance, it was possible to achieve low consumptions according to DIN 70030.

ECE City:	4.2 1/100 km
90 km/h constant:	3.3 1/100 km
120 km/h constant:	4.9 1/100 km

Even gasoline motorizing with automatic transmission will surely achieve its specifications with a consumption of 7.5 1/100 km (50 percent city, 45 percent at 90 and 120 km/h). However, it presumably cannot be installed and tested in the VW research car until the end of 1981.

Design Example: Safety

From what has been described so far it can be seen that with a number of technical developments special designs were followed by VW research in this project, as for example, with the aerodynamic design, the drive train, engine control system or the suggested assembly design. This enumeration can be expanded by the energy design, the environmental, material and customer designs, which, however, cannot all be adequately described in this publication. This will be done in later articles.

Nonetheless, because of the special importance something will be briefly stated about the concept of safety. It is obvious that the present level of technology in automobile development, designed to meet U.S. requirements, was taken into consideration. In this, an essential component of the structure is a general concept which, vis-a-vis our series designs, was further modified and in respect to front, rear and side collisions, represents a high safety standard. Especially for pedestrian safety several measures were implemented in the area of the front of the car for the purpose of softening accidents, as for example, a lowered bumper. In addition to these measures, which serve so-called passive safety, mention must be made here of a system which serves to improve active safety: the "automatic antilock device" (ABV) as was previously described in the section on chassis design.

Summary

With a number of partial designs, a car in the middle class was presented which, as an integral overall concept in the view of VW research, represents future trends in car development. With the priorities of low energy consumption, high safety standards, low outside noise, technically and economically justifiable exhaust gas emission, just to mention a few, it was shown which technologies will find increased use in the future in car building.

In addition to the commmitted involvement of our own staff members, the cooperation of numerous companies which are involved in this project should also be mentioned. All participants are hereby thanked for their help.

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TRANSPORTATION

BRIEFS

ATR 42 CONDITIONAL ORDERS--At the meeting of the NBAA [National Business Aircraft Association], Wright Airlines, a regional American company based at the Burke Lakefront Airport of Cleveland (Ohio), announced it had placed a conditional order and deposited a binder sum on four ATR 42 planes deliverable by year-end 1985 or the beginning of 1986 at a purchase price of $5 million (1980 value) each. Mr Gilbert Singerman, president of the company, stated that these planes will replace the Convair 600's that Wright Airlines uses on its network linking Cleveland with the large cities in the region. The ATR 42 competed for this order against the SAAB-Fairchild 340, the CAC 100, the Dash 7 and Dash 8, and the F 28. Mr Singerman added that the confirmation of the order would be communicated to the builders as soon as AEROSPATIALE [National Industrial Aerospace Company] and AERITALIA have made known, by the end of October, their decision to definitely launch the ATR 42 program. AEROSPATIALE and AERITALIA have thus far refused to reveal any information regarding conditional orders in hand for the ATR 42, but it is known that a significant number of airlines have already shown their very positive interest in this plane--an interest backed by letters of intent and cash binders. It appears that commitments under these conditions have already been made by some 10 airlines, including Wright, for 40-50 planes. The decision by AEROSPATIALE and AERITALIA to definitely launch the ATR 42 program is expected to be made known by them by the end of next month. [Text] [Paris AIR & COSMOS in French 19 Sep 81 p 9] [COPYRIGHT: A. & C. 1980] 9399

FRENCH GEAR FOR CN 235--The CASA [Aeronautical Construction, Inc.-Spain] and Nurtanio companies which have formed a joint company to develop and produce the future CN 235 commuter biturbojet, have selected, through their joint subsidiary AIRTEC [expansion unknown], a landing gear designed by Messier-Hispano-Bugatti. The French firm is developing for this program a specific landing gear characterized by: simplicity of design: mono-wheel forward landing gear, and main landing gear with tandem wheels, each equipped with lever suspensions suited for emergency-strip landings; easy maintenance; suitability for use under extreme hot or cold climatic conditions; and extended operational life. It is recalled that the first CN 235 deliveries are scheduled for 1984. More than 70 orders have been received to date. [Text] [Paris AIR & COSMOS in French 19 Sep 80 p 15] [COPYRIGHT: A. & C. 1980]

FUNDING FOR MDF 100--The Netherlands government has announced that it is prepared to furnish 1.7 billion florins toward the funding of the Fokker and McDonnell Douglas MDF 100 project. This sum more than doubles the amount of aid initially planned (800 million florins). Mr Gijs van Aardenne, the outgoing minister of economic affairs of the Netherlands, submitted a statement in this regard, prior to his leaving office, to the Parliamentary Permanent Committee on Economic Affairs, in which he indicated that this governmental aid consists of credits in the amount of 800 million florins and reimbursable loans in the amount of 900 million florins backed by state guarantees. The funds will be made available to Fokker beginning the end of this year. As of now, however, 53 million florins have been furnished to Fokker for related design studies. Mr van Aardenne revealed that a division of effort had been made between Fokker and McDonnell Douglas, the Dutch builder having been designated prime contractor for the design and the supply of components for the MDF 100, while McDonnell Douglas is prime contractor for the marketing operation. For the moment, the plan calls for a single source of primary components but two assembly plants--one in the United States and one in Europe. The two builders expect to receive a reply by the end of this year to the offer of cooperation they have extended to Japanese builders. [Text] [Paris AIR & COSMOS in French 19 Sep 81 p 8] [COPYRIGHT: A. & C. 1980]
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